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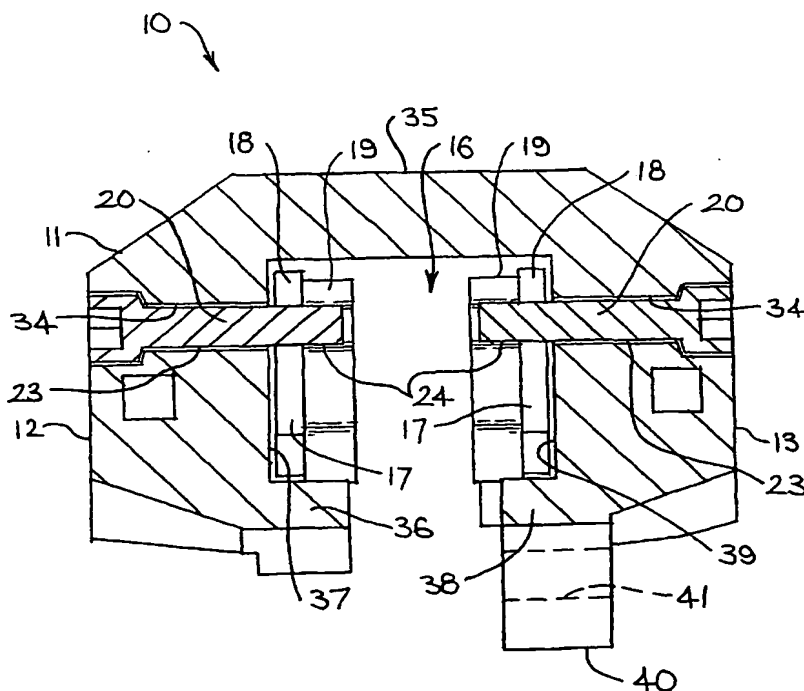
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(54) Title: **IMPROVED DISC BRAKE CALIPER**



(57) Abstract: An opposed piston disc brake caliper (10), including a caliper housing (11) arranged for mounting brake shoes on each of opposite sides of a rotor which in use is disposed between the brake shoes (17), each brake shoe (17) having radially inner (26) and outer (27) edges when mounted in the housing (11) and side edges (28, 29) extending therebetween. A piston is associated with each brake shoe (17) and is operable in use to shift the respective brake shoe (17) toward the rotor for engagement therewith to effect braking. First mounting means (20) for mounting the brake shoes (17) within the housing (11), and second mounting means (41) for mounting the caliper (10) to a wheel assembly. The second mounting means (41) extending from the housing (11) on one side of the rotor. The housing (11) including side walls (12, 13) which extend generally in planes parallel to the plane of the rotor and on opposite sides of the rotor plane and which accommodate the pistons, and end walls (14, 15) which extend transverse to the side walls (12, 13) and

are connected therebetween. An axial extension (36) that extends axially from a first of the side walls (12) towards the rotor from a position adjacent the radially inner brake shoe edge (26) and fully along the first side wall (12) to connect with each of the end walls (14, 15) and the first side wall (12) being disposed on the side of the rotor opposite to that of the second mounting means (41).

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IMPROVED DISC BRAKE CALIPER

The present invention relates to disc brake calipers and to improvements thereof. The present invention has particular relevance to disc brake calipers of the kind which include opposed pistons and it will therefore be convenient to describe the invention in relation to that type of caliper. It is to be appreciated however, that the invention could apply to calipers not of the opposed piston kind.

Opposed piston calipers have traditionally been applied to high performance vehicles, such as racing cars and top end sports cars. Such calipers have been perceived as providing higher performance than non-opposed piston calipers.

When used in high performance cars, the brake shoes of the caliper are supported on torque abutments positioned on the radially inward edge of the shoe (relative to the rotor), and a spring bias operates on the opposite or radially outer edge of the shoe to resist movement of the shoe away from one or each of the abutments during braking. The calipers are arranged in this manner, so that the brake shoes can be removed quickly after the spring or springs are removed, through an opening in the radially outer part of the caliper housing. However, the springs are required to be highly loaded to resist the signification loads applied by the brake shoes during braking. This does mean that the disassembly and reassembly of the caliper requires some expertise if it is to be done in a quick manner. This is one reason why the calipers have generally been used on high performance vehicles only.

Given the need for an opening in the housing for brake shoe removal, known opposed piston calipers such as those described above, have not been as stiff as desirable. Caliper stiffness is always a characteristic that is desirable to be maximised.

In known disc brake calipers friction lining wear tends to occur in a tapered manner, with the wear being maximum at the leading end of each shoe and tapering to minimum wear at the trailing ends. To eliminate or reduce the amount of tapering wear, ie to cause the friction lining to wear evenly or more evenly, some calipers have employed multiple pistons to drive the brake shoe, with a piston of greater diameter at the trailing end of the brake shoe compared

to the leading end. Accordingly, greater pressure is applied to the brake shoe at the trailing end than the leading end, so having an evening effect on the friction lining wear. A drawback associated with this approach is that each caliper requires at least two different piston sizes and related seals and other parts, so complicating the manufacture and assembly process and therefore increasing costs.

It is an object of the invention to overcome or at least alleviate one or more of the drawbacks associated with the prior art.

According to the present invention there is provided an opposed piston disc brake caliper, including a caliper housing arranged for mounting brake shoes on each of opposite sides of a rotor which in use is disposed between said brake shoes, each said brake shoe having radially inner and outer edges when mounted in said housing and side edges extending therebetween, a piston associated with each said brake shoe and being operable in use to shift the respective brake shoe toward the rotor for engagement therewith to effect braking, first mounting means for mounting said brake shoes within said housing, and second mounting means for mounting said caliper to a wheel assembly, said second mounting means extending from said housing on one side of the rotor, said housing including side walls which extend generally in planes parallel to the plane of the rotor and on opposite sides of the rotor plane and which accommodate said pistons, and end walls which extend transverse to said side walls and are connected therebetween, an axial extension that extends axially from a first of said side walls toward the rotor from a position adjacent said radially inner brake shoe edge and fully along said first side wall to connect with each of said end walls and said first side wall being disposed on the side of the rotor opposite to that of the second mounting means.

The above arrangement provides for increased stiffness of the caliper housing by the provision of the axial extension. The axial extent of the extension determines the increase in stiffness achieved over a caliper in which the axial extension is absent, but the maximum extent is determined by a need to avoid engagement with the rotor.

A major increase in the stiffness of the housing is realised by a single axial extension, which extends along the side wall described, although additional stiffness can be realised by a second axial extension extending from

the opposite side wall and in connection with each of the end walls and adjacent the radially inner brake shoe edge of the brake shoe or shoes on that side of the rotor. The increased stiffness provided by the second axial extension is less than that provided by the first axial extension, because the second mounting means already contributes some stiffness to that side wall of the housing.

The or each axial extension can have any suitable configuration but preferably each has a generally square or rectangular configuration.

In a preferred arrangement, the first mounting means are mounting members which extend from the housing for engagement with each side edge of each brake shoe and the engagement being such as to substantially limit movement of each brake shoe other than in a direction toward or away from the rotor. At least one of the mounting members engaged with each brake shoe is removable from the housing to facilitate removal of a brake shoe from the housing.

In a further preferred arrangement, two or more brake shoes are mounted in the housing on each side of the rotor. In this arrangement, a piston is associated with each brake shoe and sufficient mounting members are provided for engagement of the side edges of each brake shoe. In one such preferred arrangement, a pair of brake shoes are provided adjacent one another on each side of the rotor and in this arrangement, three mounting members are provided, one to engage each of the outer side edges of each brake shoe and the third to engage the side edges of the brake shoes which are adjacent. In this arrangement, the central or third mounting member can be removable, whereby removal of that member alone can facilitate removal of the pair of brake shoes from the housing. That is, the arrangement can be such that by removal of the central or third mounting member, the restraint against movement of the brake shoes by the mounting members is lifted, so that the brake shoes can then be removed.

In a further arrangement, three brake shoes are provided adjacent one another on each side of the rotor. Accordingly, four mounting members can be provided, one at each end of the adjacent brake shoes and one disposed between each of the two pairs of adjacent side edges. In this arrangement, the mounting members disposed between the two pairs of adjacent side edges can be removed for removal of each of the three brake shoes.

It will be appreciated that any number of brake shoes and associated mounting members may be provided and that for brake shoe removal, mounting members disposed between adjacent side edges of adjacent brake shoes normally will be required to be removed for brake shoe removal. Alternatively
5 however, each of the mounting members may be removable, and this may be desirable not only to provide flexibility in which members may be removed, but also to maximise the number of like parts in the caliper.

In an alternative arrangement, some of the mounting members may be fixed against removal and for example, one or more of the mounting members
10 may be cast as part of the housing. Alternatively, those members may be disposed as a friction fit in openings formed in the housing. The number of fixed mounting members is however limited by the requirement for brake shoe removal.

In a preferred arrangement, one or more of the mounting members is
15 threadably received in an opening in the housing. Preferably the opening extends fully through the housing so that the member is threaded into the opening from the outside of the housing, thereby facilitating removal of the member from the outside. The or each member may therefore be formed as threaded stud or the like, with an outwardly exposed head which includes a
20 suitable configuration for engagement with a driving tool, such as a spanner.

The mounting members may engage the side edges of the brake shoes in any suitable manner to limit brake shoe movement as required. In one preferred arrangement, the backing plate of the brake shoes include a slot or groove formed in a side edge and the mounting member has an outer surface to
25 snugly engage that slotted or grooved surface. The slot or groove may have any suitable shape, such as concave, while the mounting member, at least in the region of the backing plate may be circular in cross-section. In this arrangement, the slot or groove may be of a radius slightly greater than that of the mounting member for a snug fit about the mounting member. The slot or
30 groove may however be otherwise shaped.

The engagement between the mounting member and the brake shoe may alternatively be the opposite to that discussed above, so that the mounting member includes a slot or groove and the backing plate includes a protrusion which is a snug fit in the slot or groove.

The mounting members must extend from the housing to maintain engagement of the brake shoes during movement thereof into engagement with the rotor. That movement will be a minimum when the friction lining of the brake shoe is new and at a maximum when the friction lining has worn. The amount of movement will vary but typically the maximum movement when the friction lining has worn will be in the order of 2 to 3mm.

The brake shoes preferably are of identical shape to minimise different parts. The brake shoes typically are of generally rectangular or square construction, and if multiple brake shoes are employed on each side of the rotor, they preferably have a combined length approximately equal to that of a single brake shoe. The number of brake shoes can vary as discussed above, and one arrangement that has been envisaged includes a six brake shoe caliper (three brake shoes on each side of the rotor) for the front wheels of a vehicle and a four brake shoe caliper for rear wheels thereof. It is possible to have different numbers of shoes on each side of the rotor if desirable, such as a traditional single shoe on one side and a pair of shoes on the other. The invention therefore is not restricted to even numbers of brake shoes.

The caliper arrangement of the invention preferably includes biasing means for biasing the brake shoes against rattling movement and for this, a light spring may be employed to bias the brake shoes into engagement with the mounting members against rattling. The biasing force required for this can be substantially less than the spring employed in the prior art discussed above, because it has a very different purpose and is not required to resist the substantial loading of the prior art caliper during braking.

In an alternative embodiment, an opposed piston disc brake caliper is provided in which the caliper housing is arranged for mounting a plurality of brake shoes on each of opposite sides of a rotor and a piston is associated with each brake shoe. The end and side walls of the housing define an opening, and the caliper includes a bar extending across the opening transverse to the side walls for increasing the stiffness of the housing against outward bending of the side walls during braking, the brake shoes being removable from the housing through the opening past the bar when the caliper is installed about a rotor.

The above embodiment is advantageous by the provision of both the plurality of brake shoes on each side of the rotor and the transverse bar which traverses the housing opening. In the prior art, a transverse bar could not be employed with single brake shoes disposed on either side of the rotor, because
5 the bar prevented brake shoes being removed from the caliper through the opening. However, brake shoes of lesser length parallel to the plane of the rotor can be removed through the housing on either side of the bar.

There can be more than a single transverse bar if the relative dimensions of the opening and the brake shoes permit. In a six brake shoe caliper, the
10 length of the housing in the plane of the rotor can be greater than in a four brake shoe caliper and a pair of transverse bars may be employed in a six brake shoe caliper, whereas a single bar may be employed in a four brake shoe caliper.

In a further preferred embodiment, the housing side walls include piston
15 bores for accommodating each piston, and each of the piston bores have the same diameter and axial extent and each piston has the same diameter and length, so that during braking, equal pressure is applied to each brake shoe.

In the above embodiment, caliper costs can be reduced by the piston arrangements being identical, rather than different. Such an arrangement
20 previously would have not been desirable, because the friction lining would wear in a tapered profile as discussed earlier. However, by employing a plurality of brake shoes on each side of the rotor, the shortened length of each brake shoe in the direction of rotor rotation, means that while the friction lining of each shoe will still wear in a tapered profile, the extent of tapered wear will be
25 lessened. Accordingly, the friction lining will wear more evenly and will therefore have an extended life.

The attached drawings show an example embodiment of the invention of the foregoing kind. The particularity of those drawings and the associated description does not supersede the generality of the preceding broad
30 description of the invention.

Figure 1 is a perspective view of a disc brake caliper according to the invention.

Figure 2 is a plan view of the disc brake caliper of Figure 1.

Figure 3 is a shows an internal arrangement of the disc brake caliper.

Figure 4 is a perspective view of the disc brake caliper of Figure 1 showing brake pads and mounting pins removed.

Figure 5 is a cross-sectional view through the pad arrangement of a two brake shoe disc brake caliper.

5 Figure 6 is a cross-sectional view taken through VI – VI of Figure 2.

Figure 7 is a view of the Figure 5 illustration shown pistons and piston bores.

Figure 1 shows a disc brake caliper according to the invention as described above. The disc brake caliper 10 includes a housing 11 defining a pair of parallel side walls 12 and 13 and a pair of end walls 14 and 15 which extend transversely to the side walls 12 and 13 and are connected thereto. The housing 11 has a generally rectangular configuration in plan view and typically would be cast in a suitable metal such as iron or aluminium. The housing would then be machined as necessary.

15 The side walls 12 and 13 and the end walls 14 and 15 define an opening 16 in the housing 11. The opening 16 is of generally rectangular configuration and the internal surfaces of the opening defined by the side walls 12 and 13 are machined for mounting of a plurality of brake shoes 17 there against. In Figure 1, three brake shoes 17 are mounted to each side wall 12 and 13 and each
20 brake shoe consists of a metal backing plate 18 and a friction lining 19. While these parts of the brake shoes can be seen from Figure 1, they are better illustrated in Figure 2.

The brake shoes 17 are mounted within the housing 11 in a unique manner, by mounting members which are illustrated clearly in Figures 3 and 4. Referring to Figure 3, the brake shoes of Figures 1 and 2 are shown and it can be seen that these are aligned side by side and one set of three brake shoes is spaced apart from the other set of three shoes. That spacing is to accommodate a disc brake rotor which is not shown in any of the drawings, but which would be disposed between the sets of brake shoes, so that the brake
30 shoes can be shifted into engagement with the rotor to apply a braking effect.

The mounting members shown in Figure 3 consist of a plurality of threaded pins 20 which include a head 21 incorporating a hexagonal recess 22 for receipt of a complimentary shaped driving tool, a threaded shaft portion 23 and a non-threaded shaft portion 24. The threaded portion 23 has a greater

diameter than the shaft portion 24 and therefore a step 25 is defined at the junction between the respective portions 23 and 24.

Referring to Figure 4, each brake shoe 17 is of generally rectangular configuration, having a radially inner edge 26, a radially outer edge 27 and side edges 28 and 29. The brake shoes 17 are not strictly rectangular as can be seen from Figure 4, as the inner edge 26 is formed of three flat surfaces, the outer edge 27 is curved and the side edges 28 and 29 are angled slightly inward. The brake shoe configuration can be configured in any suitable manner such as that shown or as otherwise required.

As is evident in Figures 3 and 4, the side edges 28 and 29 each include a part-circular slot or groove 30, while the friction lining also includes a slot or groove 31 coaxially aligned with the groove 30. The radius of each of the grooves 30 and 31, is slightly greater than the radius of the shaft portion 24 of the pins 20 so that the grooves 30 and 31 are a snug fit about the shaft portions 24. As is shown in Figure 3, the shaft portion 24 of each mounting pin 20 is disposed in each of the grooves 30 and 31 of each brake shoe 17. It should be clear that the arrangement shown in Figure 3 will permit each of the brake shoes to move axially with respect to the shaft portion 24 of each of the mounting pins 20, but to be substantially restrained against movement transverse to the axial extent of the shaft portion 24. Thus, by the arrangement shown, movement of each of the brake shoes 17 can be achieved to facilitate engagement of the friction lining 19 of each brake shoe 17 with the disc brake rotor (not shown) disposed between the sets of brake shoes, but to restrain the brake shoes against movement in other directions. This arrangement is further shown in Figure 5, although the Figure 5 arrangement relates to an assembly which includes only a pair of brake shoes disposed on either side of the rotor. In this respect, a disc brake caliper according to the invention can have any number of brake shoes disposed on either side of the rotor and therefore Figure 5 is illustrative of an alternative arrangement, which is otherwise operable in a very similar manner to the Figures 1 to 4 arrangements.

In the Figure 5 arrangement, the brake shoes 32 are of the same construction and dimensions as the brake shoes 17 of the earlier figures. Accordingly, it is not necessary to further describe these. Likewise, the mounting members 33 each have the same construction as the mounting

pins 20 of the earlier figures. Again, it is therefore unnecessary to further describe those members. Figure 5 shows the snug mating engagement between the outer surface of the mounting members 33 and the slot or grooves formed in each of the brake shoes 32. It will be readily seen from this view that the shoes are constrained against rotating movement, or against lifting movement, but as explained earlier, the brake shoes can move axially with respect to the mounting members 33.

Referring to Figure 4, the brake shoes 17 may be mounted within the housing 11 by positioning each brake shoe against the machined side wall surface and inserting each mounting pin 20 into threaded engagement in the housing 11. For this, Figure 4 shows openings 34 machined into the housing 11 and to which a thread is applied for threaded engagement with the threaded shaft portion 23 of each mounting pin 20. By this arrangement, the mounting pins 20 can be easily removed when one or more of the brake shoes 17 is to be removed, although it will be appreciated that it is not necessary to remove each of the mounting pins 20 and with reference to Figure 5, the center mounting pin 33 can be removed to facilitate removal of each of the brake shoes 32, without also requiring removal of the other two mounting pins 33. In the Figure 4 arrangement, to remove each of the three brake shoes 17 on one side wall of the housing 20, the two mounting pins 20 shown removed from the openings 34 can be removed, without needing also to remove the other pair of mounting pins 20 disposed outside the pair of central pins. It is therefore acceptable, for the outside pair of mounting pins 20 to be permanently fixed within the housing 11 or to be formed integrally therewith, rather than being a separate pin which is fixed in the housing. In one alternative, the pins may be a friction fit within an opening formed in the housing 11, with the intention that they remain as a permanent part of that housing, or the shaft portions 24 of the mounting pins 20 maybe formed by a cast protrusion which extends from the machined surface of the side walls 12 and 13, instead of being a separate installable pin.

The extent of the mounting pins 20 into the opening 16 of the housing 11 is required to be sufficient for each brake pad to be shifted axially into engagement with the rotor and to still maintain engagement with the shaft portion 24. Figure 6 represents a cross-sectional view taken through VI-VI of Figure 2 and clearly shows the mounting pins 20 received and fastened within

the openings 34, while the unthreaded shaft portion 24 extends into the opening 16 in engagement with the side edges of the brake shoes 17. It is also clear from Figure 6, that the shaft portion 24 extends for about twice the axial thickness of the backing plates 18 so that brake shoe movement toward a rotor disposed between the brake shoes 17 is facilitated without disconnection between the brake shoes 17 and the shaft portions 24. It will be appreciated, that as the friction linings 19 wear, that the brake shoes 17 will travel a greater distance to engage the rotor and this is the reason for providing a significant axial extent of the shaft portions 24.

Returning to Figures 1 and 2, bars 35 extend transversely across the opening 16 generally parallel to the end walls 14 and 15 and transverse to both the plane of the rotor and the side walls 12 and 13. The bars 35 are formed as an integral casting of the housing 11, although they could be alternatively connected as separate components. As shown, the bars are spaced apart in equal increments from themselves and from the end walls 14 and 15. There is no strict requirement for this spacing although it also means that the bars 35 are aligned with the centre pair of mounting pins 20.

The bars 35 increase the stiffness of housing 11 under braking conditions and resist bending of the side walls 12 and 13 in such conditions. However, the provision of the bars 35 as shown also facilitates insertion or removal of individual brake shoes 17 upon removal of the required number of mounting pins 20. Thus the caliper 10 does not need to be fully removed from a wheel assembly of a vehicle to which it is fitted for removal of one or more of the brake shoes 17. Instead, it is a relatively simply matter of removing the required number of mounting pins 20 and then removing through the opening 16, the required number of brake shoes 17. Figure 4 is illustrative of this method, in which two of the mounting pins 20 are shown removed from the housing 11, to facilitate complete removal of three of the brake shoes 17.

Referring to Figure 6, a further stiffen mechanism is applied to the caliper 10 to increase overall caliper stiffness. In Figure 6, the bar 35 is shown but additional to this, the side wall 12 includes an axial extension 36 which extends from the machined surface 37 of the side wall 12 axially toward the rotor or opposite side wall 13. To obtain the stiffness benefit, the axial extension 36 extends in connection with end wall 14 fully to and in connection with the end

wall 15. Thus, the axial extension is effectively a ledge which is formed along the full internal length of the side wall 12.

For further enhancing the housing stiffness, a second axial extension 38 extends from the machined surface 39 of the side wall 13. That axial extension extends axially inwardly and fully between the respective end walls 14 and 15. The provisions of the axial extension 38 is not as important as the opposite extension 36, because the side wall is already stiffened to a certain extent by the provision of a mounting knuckle 40 which serves to mount the housing 11 to the wheel assembly. The knuckle 40 may take any suitable shape or form to achieve its mounting requirement. For example and referring to Figure 5, the knuckle is a radius extension of the side wall 13 and includes an opening 41 to receive a fixing bolt (not shown). However, any suitable mounting means or arrangement may be employed for mounting the housing to the wheel assembly.

The brake shoes 17 or 32 are displaced towards a disc brake rotor generally by hydraulic pistons and as discussed previously, the use of multiple brake shoes as shown in each of the earlier figures, permits the pistons and their associated piston bores to be of the same dimensions throughout the caliper. Figure 7 represents this arrangement, in which the pistons 42 and their associated bores 33 are of identical dimensions. This arrangement will still entail tapered wear of each brake shoe friction lining, but because the brake shoes have a reduced length in the direction of rotor rotation, the degree of tapering wear of each brake shoe will be less than the tapered wear of a single brake shoe.

It will be appreciated that the figures show a single piece housing, or monoblock housing construction, although alternatively, the housing could be cast and machined in two parts and then bolted or otherwise connected together. It should also be appreciated, that the caliper 10 does not show a biasing spring engaging the brake shoes 17 or 32, however it is envisaged that such a spring would be included as an anti-rattling device, to urge the brake shoes into firm connection with each mounting pin 20. The spring could act on either of the brake shoe edges 26 or 27 and a single spring may be provided to engage all of the brake shoes of the caliper 10, or all of the brake shoes

mounted on one side of the caliper 10, or a single brake shoe each. The spring could take a variety of different forms, although a leaf spring is envisaged.

The invention described herein is susceptible to variations, modifications and/or additions other than those specifically described and it is to be understood that the invention includes all such variations, modifications and/or additions which fall within the spirit and scope of the above description.

CLAIMS

1. An opposed piston disc brake caliper, including a caliper housing arranged for mounting brake shoes on each of opposite sides of a rotor which in use is disposed between said brake shoes, each said brake shoe having radially inner and outer edges when mounted in said housing and side edges extending therebetween, a piston associated with each said brake shoe and being operable in use to shift the respective brake shoe toward the rotor for engagement therewith to effect braking, first mounting means for mounting said brake shoes within said housing, and second mounting means for mounting said caliper to a wheel assembly, said second mounting means extending from said housing on one side of the rotor, said housing including side walls which extend generally in planes parallel to the plane of the rotor and on opposite sides of the rotor plane and which accommodate said pistons, and end walls which extend transverse to said side walls and are connected therebetween, an axial extension that extends axially from a first of said side walls toward the rotor from a position adjacent said radially inner brake shoe edge and fully along said first side wall to connect with each of said end walls and said first side wall being disposed on the side of the rotor opposite to that of the second mounting means.
2. An opposed piston disc brake caliper according to claim 1, said housing further including a second axial extension which extends axially toward said rotor adjacent said radially inner brake shoe edge and fully along said side wall to connect with each of said end walls and disposed on the same side of the rotor as that of said second mounting means.
3. An opposed piston disc brake caliper according to claim 1 or 2, said axial extension having a generally square or rectangular axial cross-section.
4. An opposed piston disc brake caliper according to any one of claims 1 to 3, said first mounting means comprising mounting members extending from said side walls of said housing toward said rotor and being provided for engagement with each said side edge of each said brake shoe and the

engagement being such as to substantially limit movement of each said brake shoe other than in a direction toward or away from the rotor, at least one of said mounting members being removable from said housing to facilitate removal of a said brake shoe from said housing.

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5. An opposed piston disc brake caliper according to claim 4, wherein at least two said brake shoes are mounted adjacent each other in said housing on each side of the rotor.

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6. An opposed piston disc brake caliper according to claim 4 or 5, wherein a pair of said brake shoes are mounted in said housing on each side of the rotor, and three said mounting members are provided on each side of the rotor for mounting said pair of said brake shoes, two of said mounting members being positioned to engage the outer of said side edges of each of said pair of said brake shoes, and the third of said mounting members being positioned to engage each of the inner said side edges of said pair of said brake shoes which are adjacent.

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7. An opposed piston disc brake caliper according to claim 6, wherein said third member is removable.

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8. An opposed piston disc brake caliper according to claim 5, wherein three said brake shoes are mounted in said housing on each side of the rotor, comprising a pair of outer brake shoes and a central brake shoe, and four said mounting members are provided on each side of the rotor for mounting said brake shoes, two of said mounting members being positioned to engage the outer of said side edges of each of said outer brake shoes and a further two of said mounting members being positioned to engage respectively each of said side edges of said central brake shoe and the adjacent inner said side edges of said outer brake shoes.

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9. An opposed piston disc brake caliper according to claim 8, wherein said further mounting members which are positioned to engage said side edges of said central brake shoe are each removable.

10. An opposed piston disc brake caliper according to any one of claims 4 to 9, wherein each of said mounting members is removable.
- 5 11. An opposed piston disc brake caliper according to any one of claims 4 to 9, wherein mounting members which are disposed between adjacent side edges of adjacent brake shoes are removable.
12. An opposed piston disc brake caliper according to any one of claims 4 to 10 11, said mounting members being formed as pins.
13. An opposed piston disc brake caliper according to any one of claims 4 to 12, wherein one or more of said mounting members are threadably received in one or more openings formed in said housing.
- 15 14. An opposed piston disc brake caliper according to claim 13, said openings extending through the housing so that said member can be threaded into position and removed from outside said housing.
- 20 15. An opposed piston disc brake caliper according to claim 14, said threaded member including a head arranged for engagement with a driving tool from outside said housing.
16. An opposed piston disc brake caliper according to any one of claims 4 to 25 15, said brake shoes including a slot formed in each said side edge and said mounting members having an outer surface to snugly engage said slot.
17. An opposed piston disc brake caliper according to claim 16, said slots being formed concave.
- 30 18. An opposed piston disc brake caliper according to claim 17, said mounting members being formed as pins having generally circular cross-section and said slots defining a generally curved concave internal surface

complementary to the shape of the outer surface of said mounting member received within said slots.

19. An opposed piston disc brake caliper according to any one of claims 4 to
5 15, said brake shoes including a projection extending from each side edge and said mounting members including a slot for accommodating said projection.

20. An opposed piston disc brake caliper according to claim 1, said caliper
10 including two or more brake shoes mounted on each side of the rotor, and said end and side walls of said housing defining an opening, a bar extending across said opening transverse to said side walls for increasing the stiffness of said housing against outward bending of said side walls during braking, said brake shoes being removable from said housing through said opening past said bar when said caliper is installed about a rotor.

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21. An opposed piston disc brake caliper according to claim 20, said caliper including a pair of transverse bars, which are spaced apart in the plane of the rotor to each extend across said opening.

20 22. An opposed piston disc brake caliper according to claim 20 or 21, said bars being formed integrally with said housing.

23. An opposed piston disc brake caliper according to claim 1, wherein said
housing side walls include piston bores for accommodating each said piston,
25 each of said piston bores having the same diameter and axial extent and each said piston having the same diameter and length, so that during braking, equal pressure is applied each said brake shoe.

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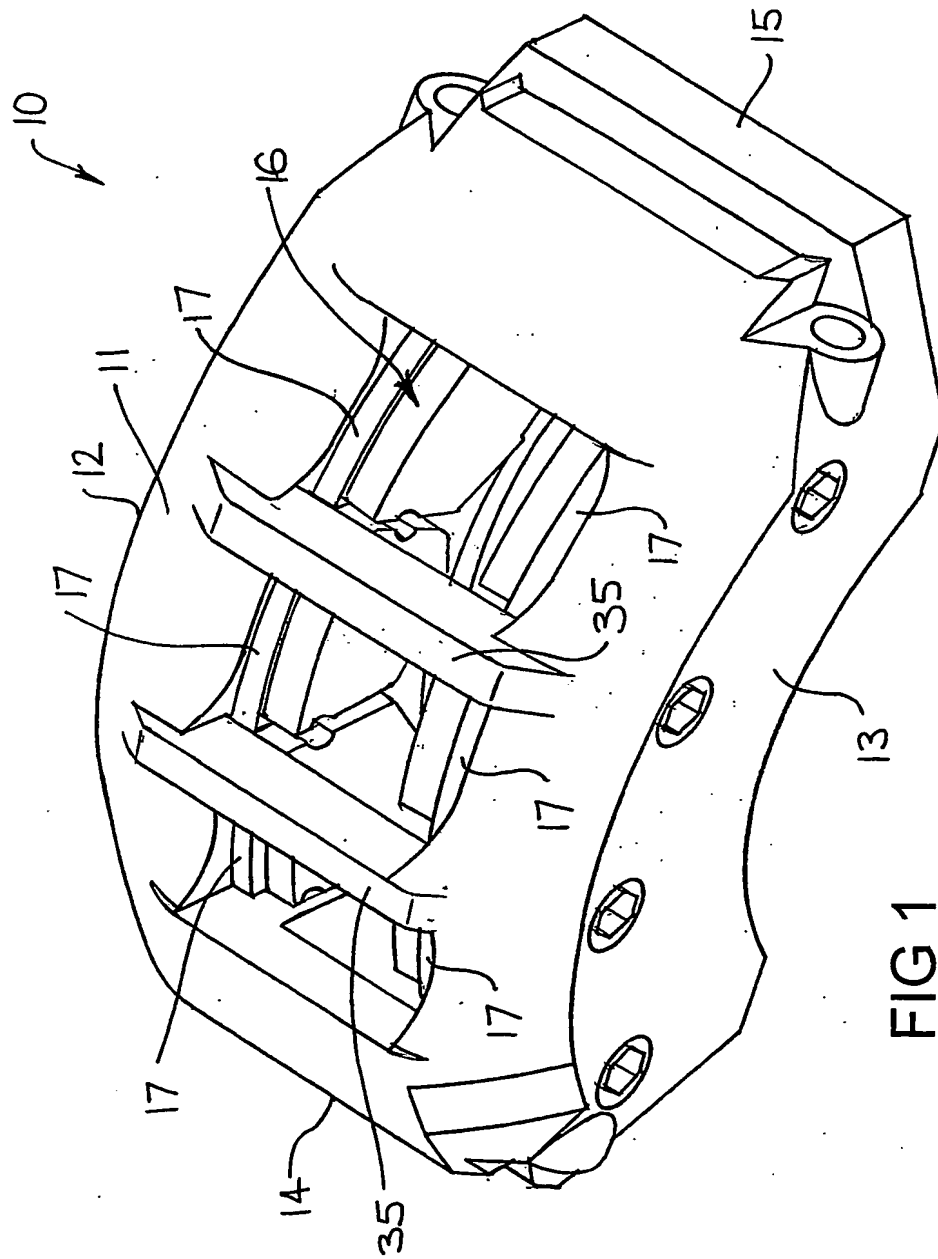


FIG 1

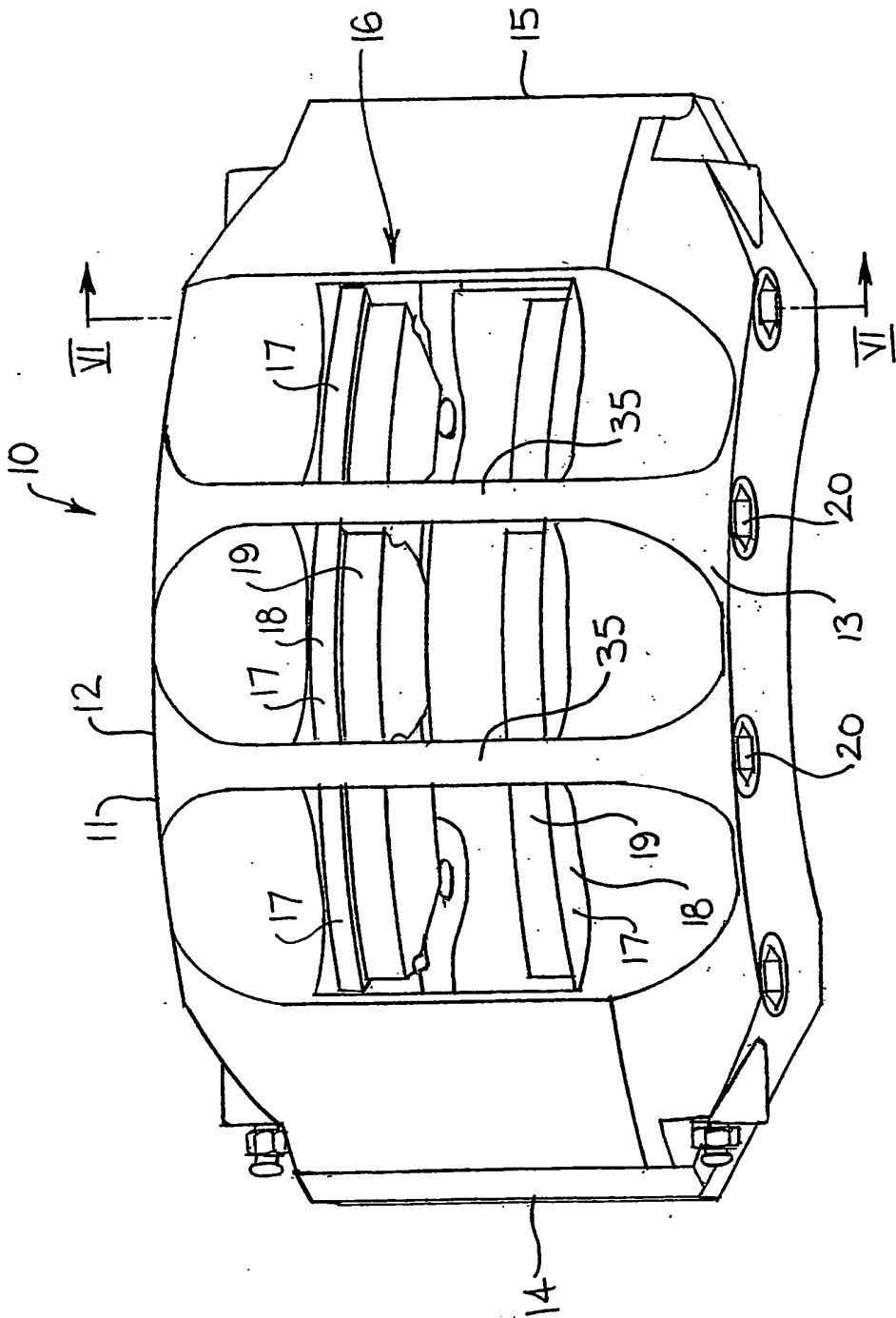


FIG 2

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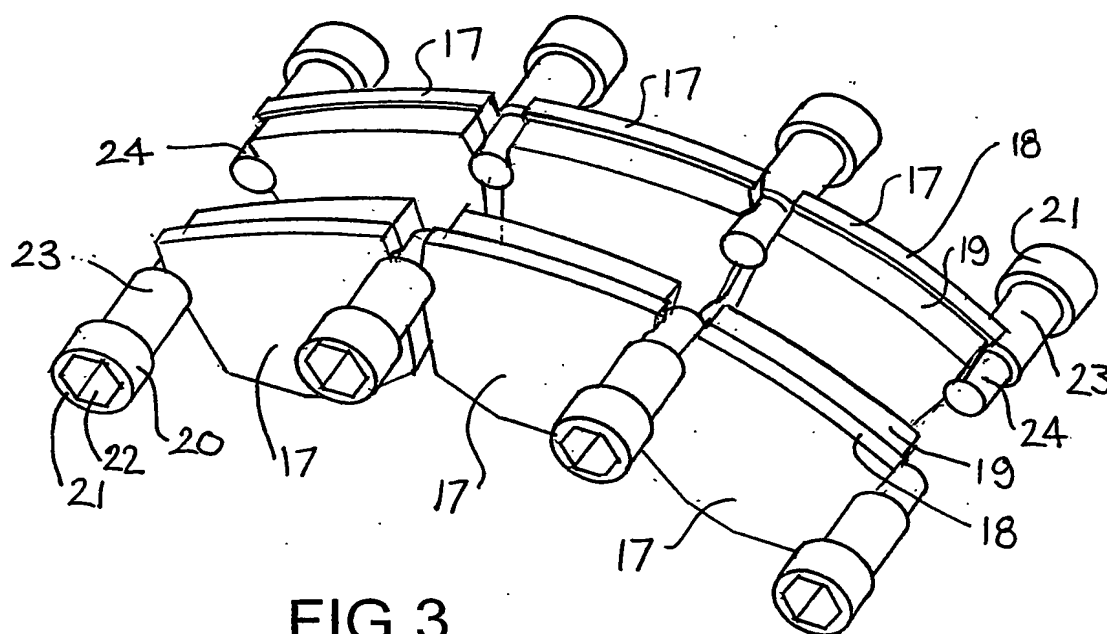
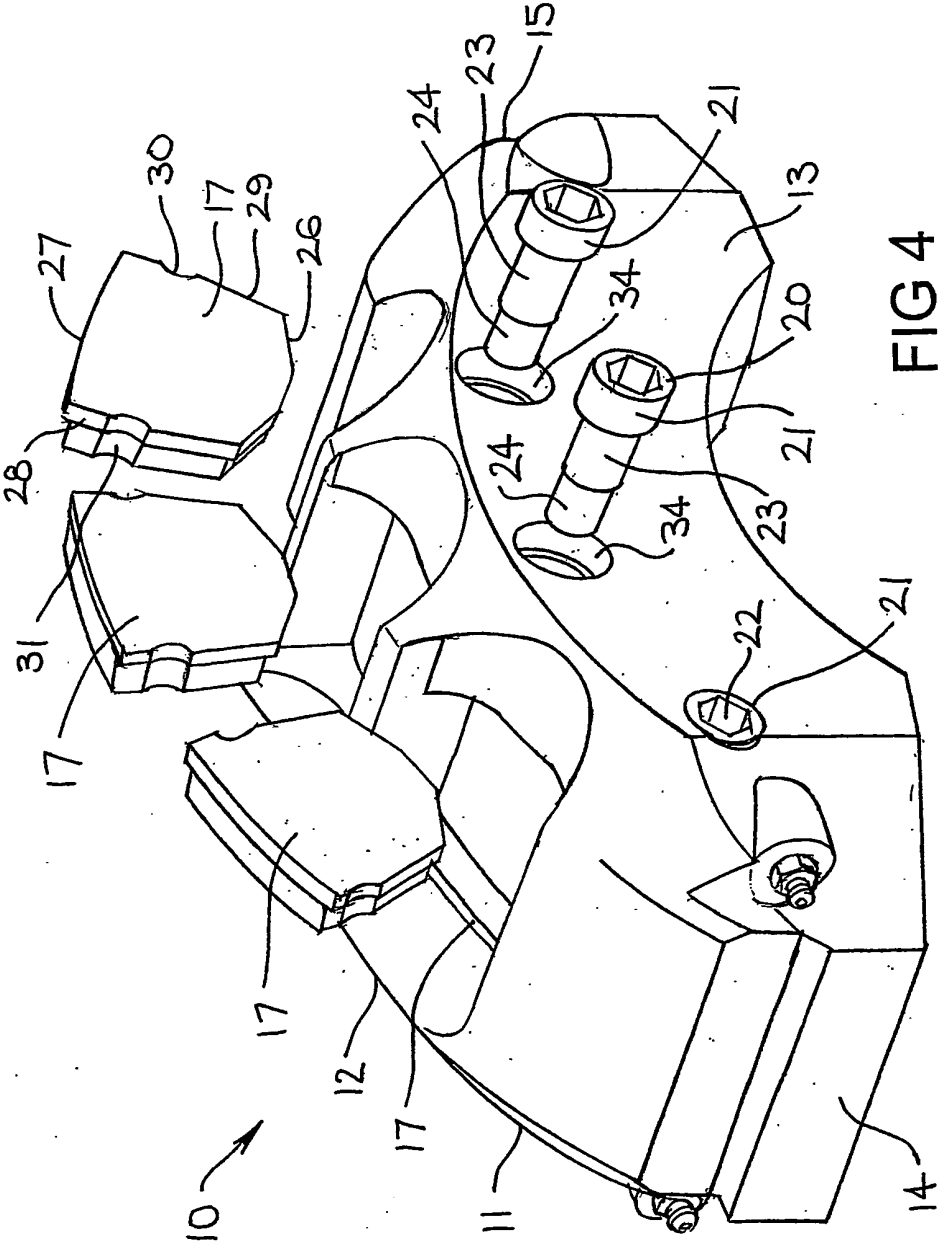
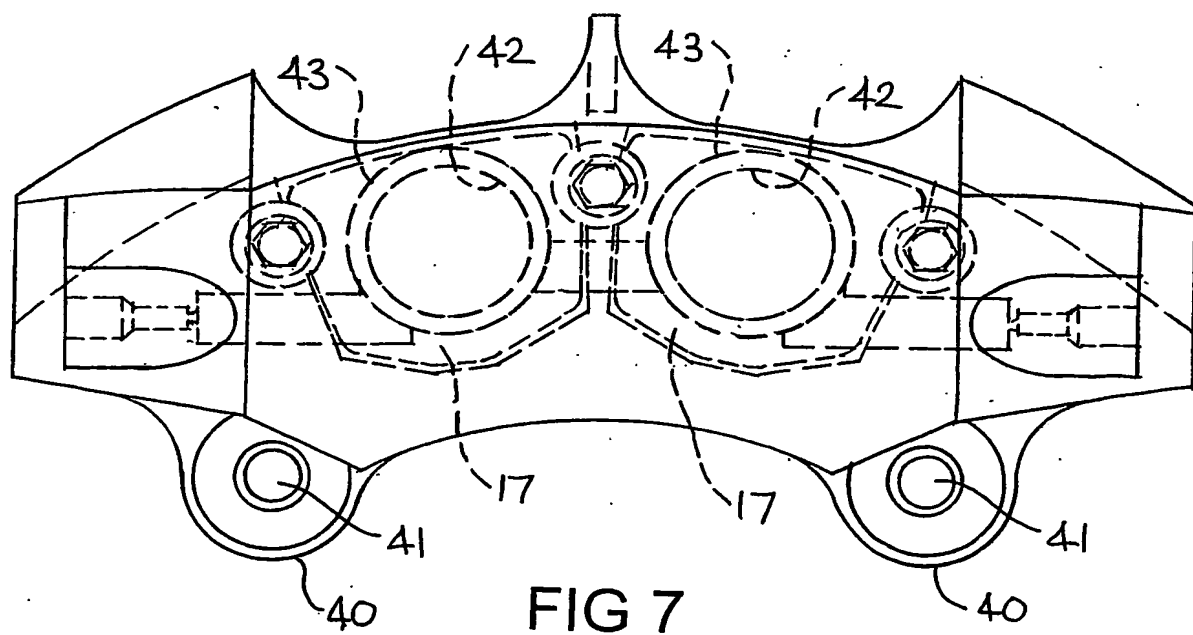
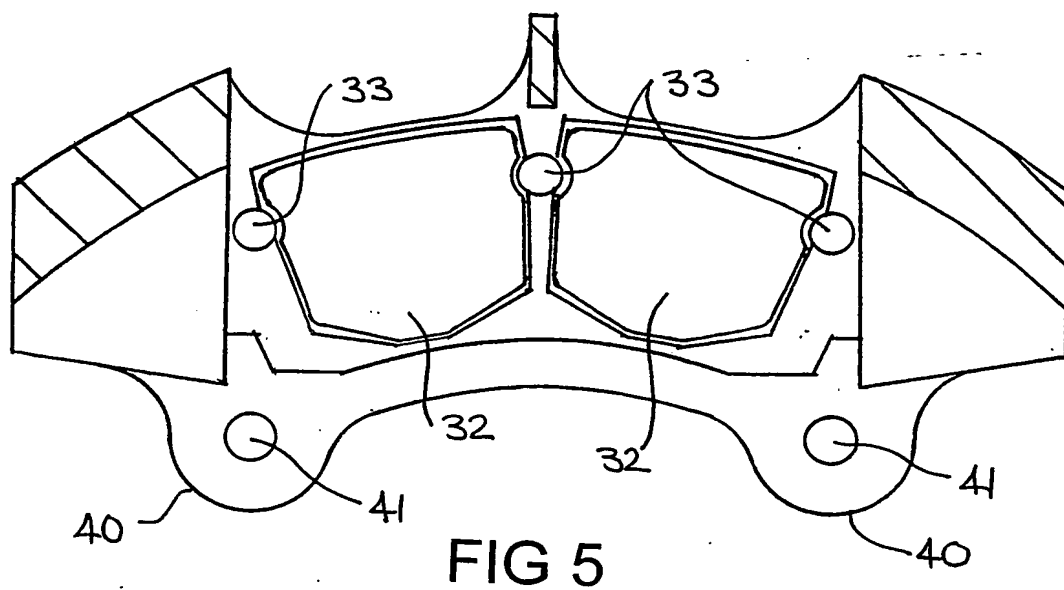


FIG 3



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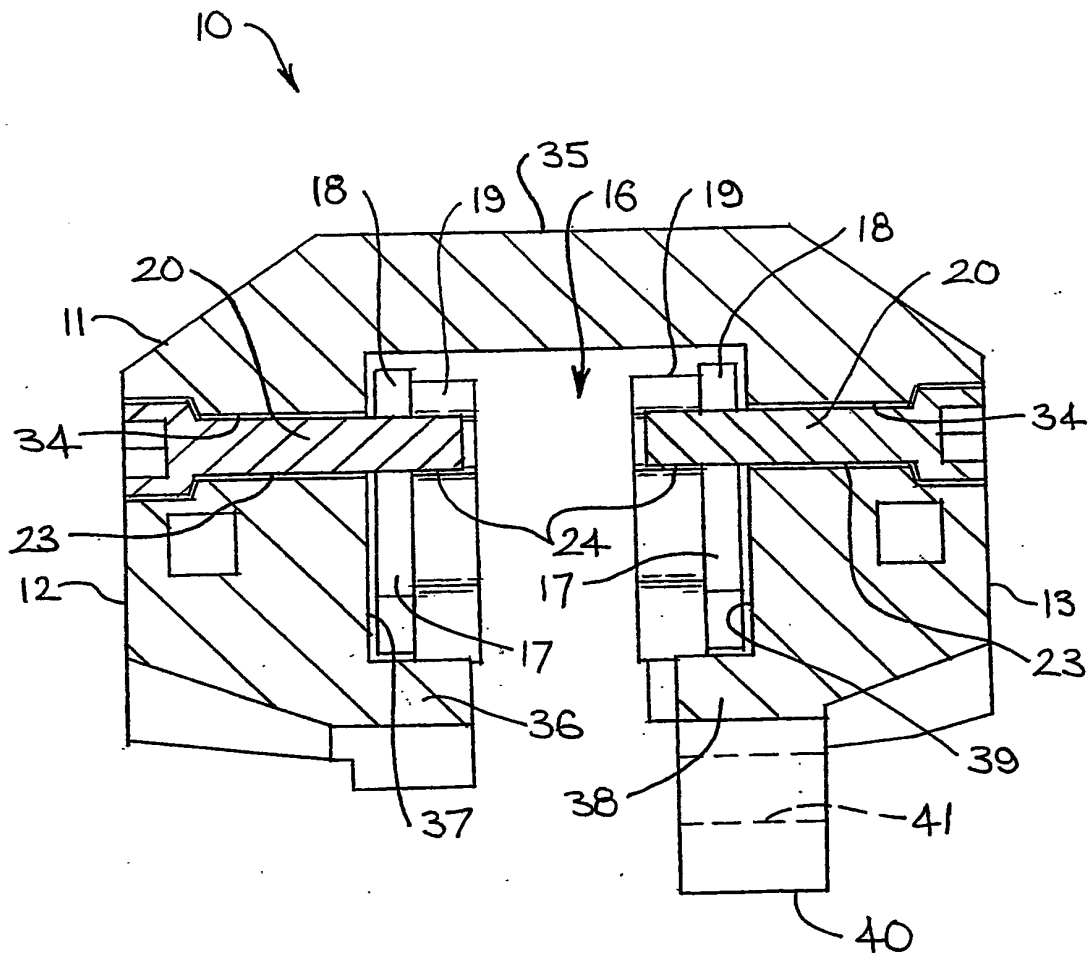


FIG 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU03/00223

A. CLASSIFICATION OF SUBJECT MATTERInt. Cl. ⁷: F16D 55/228, 65/095

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Refer electronic database consulted below

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DWPI - IPC F16D 55/22 - 55/28, F16D 65/09 - 65/097 and keywords pad/disc and housing/cage/caliper

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 3486589 A (HILLEGASS) 30 December 1969 Fig 1	1-3, 23 4-22
Y	US 3602328 A (FANNIN) 31 August 1971 Whole document	4-22
A	US 6302243 B1 (RUIZ) 16 October 2001	

☒ Further documents are listed in the continuation of Box C☒ See patent family annex

* Special categories of cited documents:

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"E" earlier application or patent but published on or after the international filing date

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
24 March 2003

Date of mailing of the international search report
27 MAR 2003

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Telephone No : (02) 6283 2377

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU03/00223

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6367595 B1 (MORI et al) 9 April 2002	
A	US 4570759 A (FERRET BOFILL et al) 18 February 1986	

Form PCT/ISA/210 (continuation of Box C) (July 1998)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU03/00223

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
US	3486589	NONE					
US	3602328	NONE					
US	6302243	AU	200129191	GB	2372081	WO	200131222
US	6367595	EP	1069332	JP	2001027267		
US	4570759	BR	8307292	EP	112766	JP	59133837
		ES	519068	ES	8401583		
END OF ANNEX							

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